

## **Vertical Processing Center**

### **BACKGROUND AND SUMMARY OF THE INVENTION**

This invention relates to a vertical machining center with a tool slide, which can be moved in a controlled manner, and with a workpiece feed on one side of a machining area, where to change the workpieces between the workpiece feed and the machining area there is a moveable vertical machining center component that can be controlled in at least one axis.

A vertical machining center of the aforementioned class that is designed as a lathe is the subject matter of EP 0 539 837. In the prior art vertical machining center, a gripping device is mounted on the two opposite sides of the tool slide, which can be moved in two axes. By moving the tool slide, the gripping device can take from the workpiece feed individual workpieces, feed them to a chuck of a spindle and, after machining, convey them from the chuck to a tray.

In CNC controlled vertical machining centers, in particular 3 and 4 axis vertical - running stand - machining centers, one introduces for the purpose of automatically changing the workpieces the workpiece holders, which are often designed as workpiece clamping carriers and which have several workpieces clamped in the holders, into the working area of the vertical machining center by means of suitable manipulation and transport devices and then clamps the respective workpiece holder into a rotary table that has a horizontal axis of rotation and is either CNC-controlled or is controlled, for example, by positive stops. The workpiece holders can be designed both as pallets, for example, with two clamping sides respectively or as clamping turrets. In such a design several

workpieces can be machined in succession by the respective multiple machining sides in one clamping operation without interruption; and thus one avoids the individual machining of workpieces and their space and time consuming clamping and unclamping operations.

This invention is based on the problem of designing a vertical machining center of the type described above in such a manner that several workpieces can be automatically changed simultaneously between the workpiece feed and/or a workpiece carrier magazine and the working area without having to make more complex the design of the vertical machining center.

This invention solves this problem in that the workpiece feed is designed for holding available and accepting workpiece holders with workpieces and is mounted so as to be in alignment with a CNC rotary table on that side of the vertical machining center, on which the respective workpiece holder is held by the CNC rotary table.

Due to this design of the vertical machining center, merely because of a linear movement several workpieces are fed simultaneously to the vertical machining center from a delivery position of a workpiece feed on a pallet or a clamping turret as far as into its working area. Therefore, altering a vertical machining center without automatic changing of the workpieces into a vertical machining center with automatic changing of the workpieces is relatively easy, especially since the existing CNC controlled components of the vertical machining center are used anyway for the linear movement.

The workpieces can be changed especially quickly and, therefore, the changing requires only that the vertical machining center be idle for a short period of time if the workpiece feed is designed as a magazine, the movement of which can be timed and which exhibits several receivers for workpiece holders. This embodiment makes it possible to change workpiece holders in the magazine during the machining operation of the vertical machining center, so that, when the vertical machining center is idle, a desired workpiece holder can be ready immediately for takeover.

The construction of the workpiece feed is especially simple, when it has a magazine wheel, which carries the receivers and can be swiveled about a central axis.

The vertical machining center can be simplified, when, according to another improvement of the invention, the CNC rotary table can be moved on guides in the direction of the workpiece feed for the purpose of changing the workpiece holders.

In vertical machining centers, which are designed as vertical milling machines, there is often, in addition to the rotary table, a counter-vise for holding the workpiece holder on the side, facing the workpiece feed and facing away from the CNC rotary table. In such a case the invention can provide that the counter-vise is mounted at right angles to the CNC rotary table so as to be traversable with the workpiece holder out of the collision area. Then the workpiece holders can be changed merely by moving the CNC rotary table.

However, it is also possible to change the workpiece holders with the counter-vise. This is especially easy in the vertical machining center if the counter-vise has a holder for clamping the workpiece carrier, which is designed for swiveling the respective workpiece carrier 180 deg. between a position facing the CNC rotary table and a position facing the workpiece feed, and if the counter-vise is traversable on guides in the direction of the workpiece feed.

Thus, there is no need for one part of the displacing drives, including the related measuring systems of the CNC rotary table or counter-vise, because to move the CNC rotary table or the counter-vise, the tool slide and the CNC rotary table or the counter-vise have docking means. Thus, there is the possibility that the tool slide drags the CNC rotary table or the counter-vise into the desired position.

An alternative to the aforementioned embodiments can also provide that to change the workpiece holders the tool slide has a gripper. This gripper docks on the side of the workpiece holder, in order to convey it then by means of its three CNC controlled linear movements from the working area directly into the workpiece carrier magazine and to deposit it there, in order to subsequently remove from its magazine the next new workpiece holder, to lift it in the same manner back into the working area and to deliver it there again to the rotary table clamping device.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a vertical machining center of the invention;

Figure 2 is a schematic drawing of the vertical machining center; and

Figure 3 is a basic schematic of a second embodiment of the vertical machining center.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 depicts a machine frame 1 with guides 2, on which a longitudinal slide 3 can be moved in a controlled manner. On this longitudinal slide 3 can be moved a cross slide 4, which carries a tool slide 5, which has a main spindle 6 and can be moved in the vertical direction to the cross slide.

Furthermore, the vertical machining center has a CNC rotary table 7, which is shown only as a block and which can be moved on guides 8, running parallel to the guides 2. On the right side of the machine frame 1 one can see a counter-vise 9, which is in alignment with the CNC rotary table 7. Also on the right side of the machine frame 1 one can see a workpiece feed 10, designed as a workpiece magazine. This workpiece feed has a magazine wheel 11, which can be swiveled about an axis 12 and has receivers 13 for workpiece holders 14. These workpiece holders 14 carry workpieces 15 and could be called, therefore,

multiparts-workpiece clamping carriers.

To load the vertical machining center with a workpiece holder 14a, the counter-vise 9 moves first to the front or the bottom. Then the CNC rotary table 7 moves in the direction of the workpiece holder 14a and accepts that end of the workpiece holder 14a that faces it. Then the CNC rotary table 7 returns with the workpiece holder 14a to the left until the counter-vise 9 moves again into its designated position and can accept the other end of the workpiece holder 14a. The CNC rotary table 7 can move by means of its own drive, which is not shown. However, it is also possible to displace it by means of the tool slide 5. The counter-vise 9 can be moved, for example, by means of a hydraulic cylinder, which is also not shown.

Figure 2 shows a workpiece holder 14a in the machining position. In this position it is held by the CNC rotary table 7 and the counter-vise 9. One can also see in Figure 2 the guides 8, on which the CNC rotary table 7 can be moved. Furthermore, Figure 2 shows rails 16, oriented at right angles to the rotary table and by which the counter-vise 9 can be moved at right angles to the travel of the CNC rotary table 7. In the position, shown in Figure 2, the CNC rotary table 7 is connected to the tool slide 5 by means of docking means 18. Thus the CNC rotary table 7 can be moved on the guides 8 by means of the tool slide 5. The docking means 18 consist of a coupling element 19 on the CNC rotary table and a ram 20 on the tool slide 5.

In the embodiment, according to Figure 3, the CNC rotary table 7 is

mounted immovably. However, the counter-vise 9 can be moved, instead, on guides 21 in the direction of the magazine wheel 11. In this embodiment the counter-vise 9 has a holder 22, which can be swiveled 180 ° about an axis 23 running perpendicularly to the guides 21. Thus, a workpiece holder 14a can be swiveled out of the position, facing the CNC rotary table 7, into a position facing the magazine wheel 11, in order to deposit the workpiece holder 14a by moving the counter-vise 9 on the guides 21 into the magazine wheel 11. Correspondingly a new workpiece holder 14 can be removed from the magazine wheel 11 and inserted into the CNC rotary table 7.

It is not shown that the workpiece feed 10 can be upstream of a separate retrofitting and multipart loading and unloading station, which can take the individual workpiece holders from the workpiece feed as a function of time in parallel to the machining semi or totally automatically in succession, in order to load there with new raw parts, to retrofit with new parts or to exchange the workpiece holder for a different one and to feed it then again in the same manner to the workpiece feed.

This application claims the priority of German patent application No. 103 11 762.8, filed March 18, 2003, the disclosure of which is expressly incorporated by reference herein.

The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur

to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.